# Socioscientific issues: Searching for new perspectives

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Evagorou & Nielsen (2019). Socioscientific issues: Searching for new perspectives. *Plenary Talk at the European Science Education Research Association Conference (ESERA)*, August 29th, Bologna, Italy.



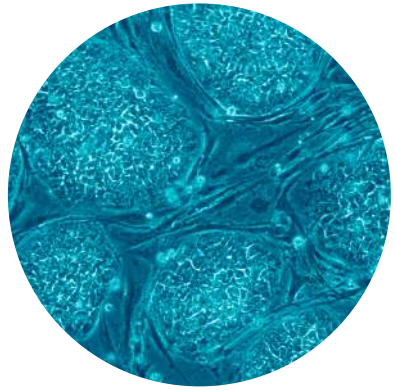


# Socioscientific issues

## Searching for new perspectives







Maria Evagorou, University of Nicosia

Jan Alexis Nielsen, University of Copenhagen

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## What are socio-scientific issues?

## What does empirical research say?


## Searching for new perspectives

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# Part 1

## What are socio-scientific issues?

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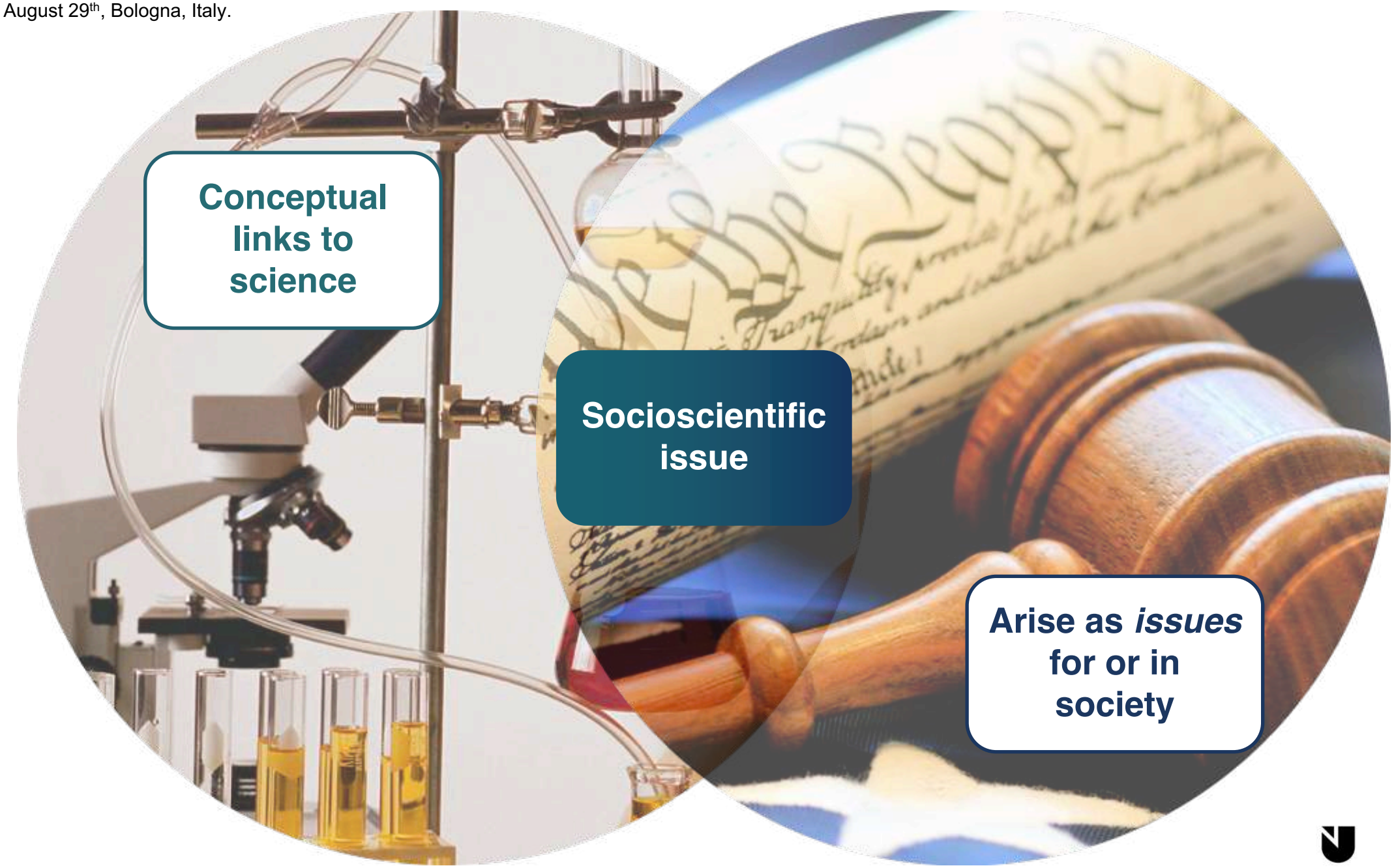


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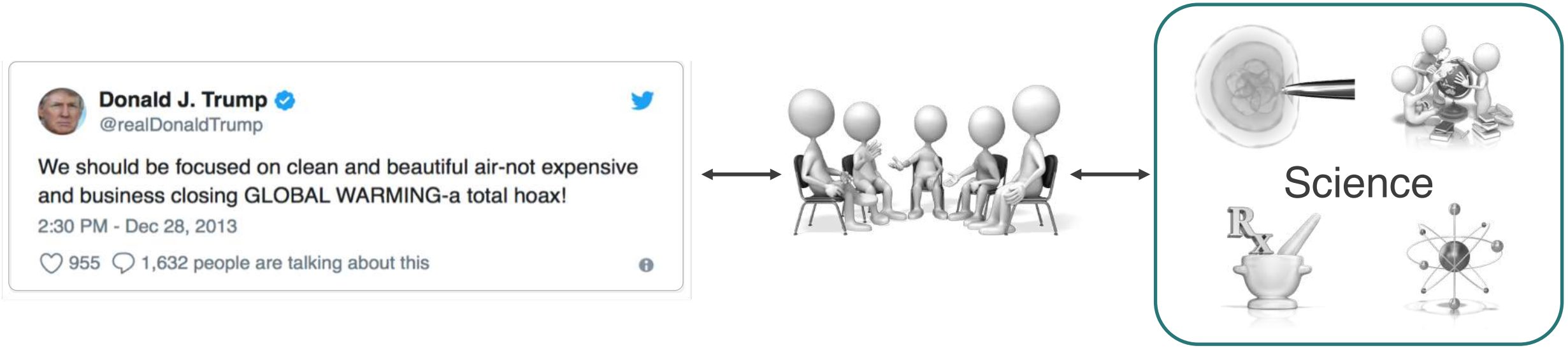


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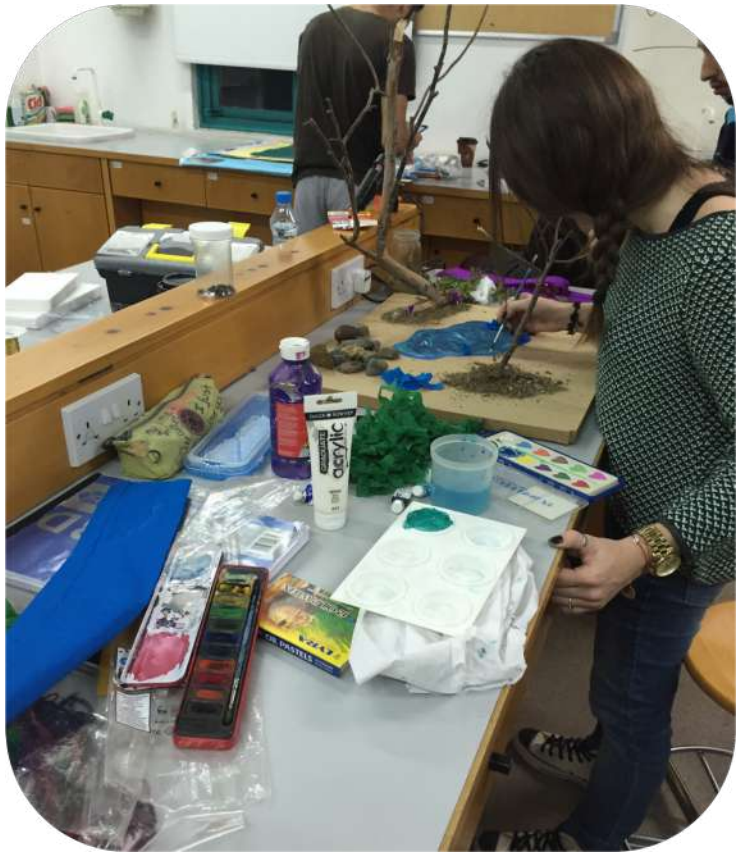
# The population of the bees worldwide is declining. Should we care, and why?



(Evagorou & Puig, 2017)

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# What is the best solution to minimize the number of mosquitoes in our area?

(Nicolaou, Evagorou & Lymbouridou, 2015)

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## Activity

Now you have seen an example of how teaching socioscientific issues could look like

Discuss with your neighbour (2 min). ***What do you think characterises a socioscientific issue?***

Type answer on www.menti.com use code XX XX XX

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# What characterises a socioscientific issue?

Controversial and contentious issues – for society and/or science

Require the use of evidence from science as well as other disciplines

Issues at the frontier of science; tentative status

Require judgement and decision-making

Require participation in discussion and debate about what to do (and possibly taking action)

Require a degree of moral reasoning and ethical evaluation

(Kolsto, 2000; Oulton, Dillon & Grace, 2004; Zeidler, 2003; Sadler, 2004; Albe, 2008; Benzce, Sperling & Carter, 2012; Salvato & Testa, 2012; Zeidler & Nichols, 2009; Nielsen, 2013; Zeidler, 2014; Nicolaou, Evagorou & Lymbouridou, 2015)

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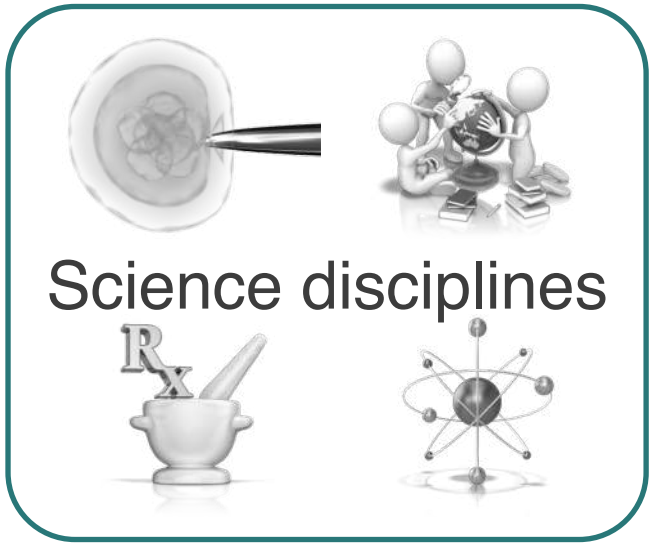
# Working definition

Socioscientific issues have a scientific component but arise as societal issues and incorporate other disciplines and knowledge domains (political, financial, ethical and moral, religious etc).



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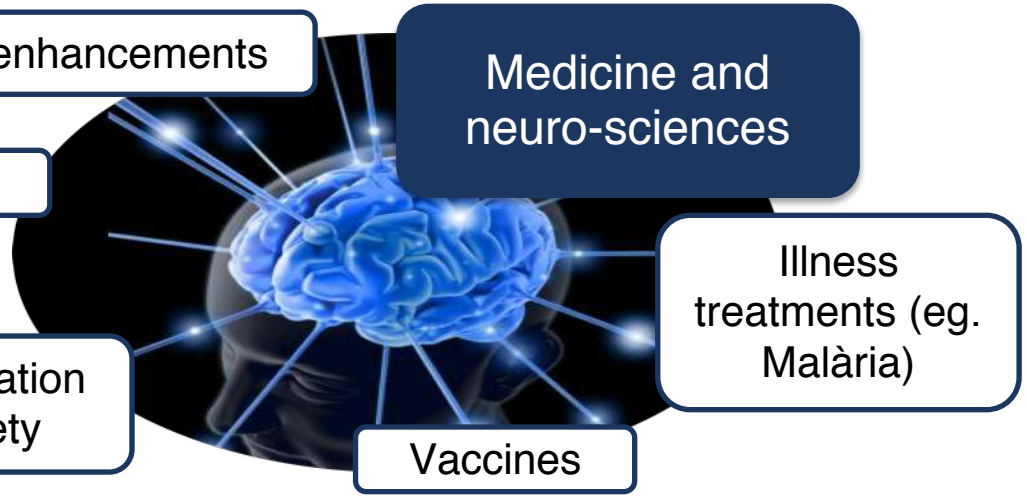
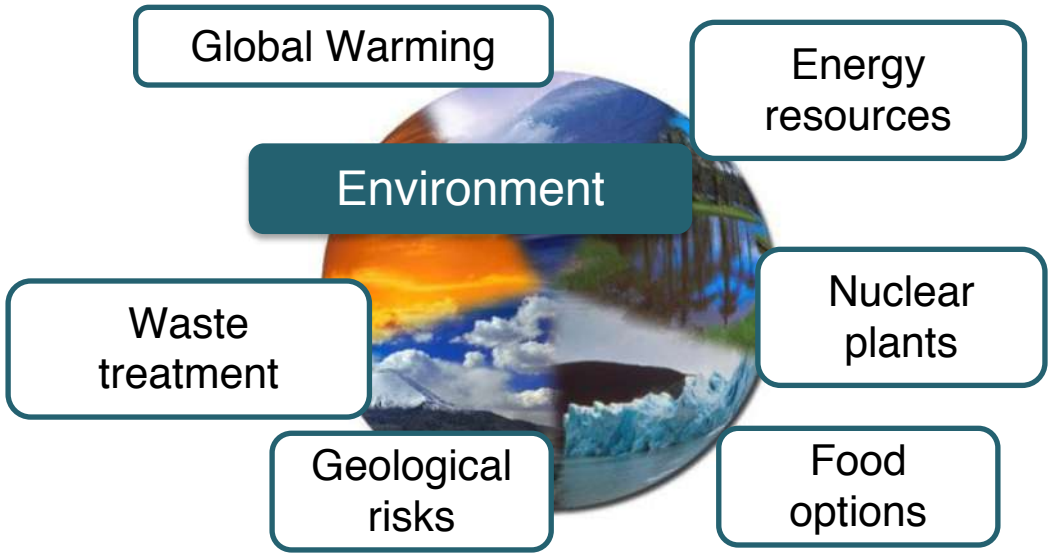
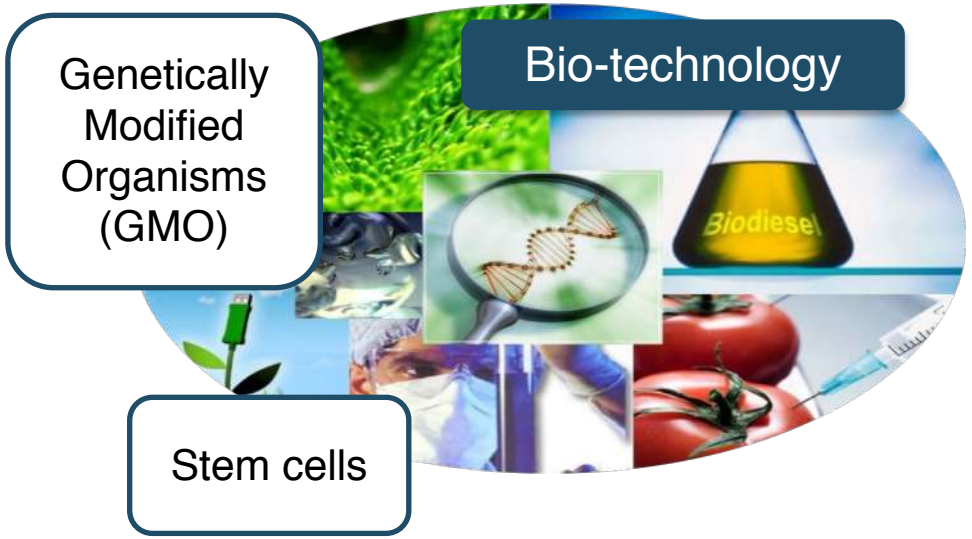
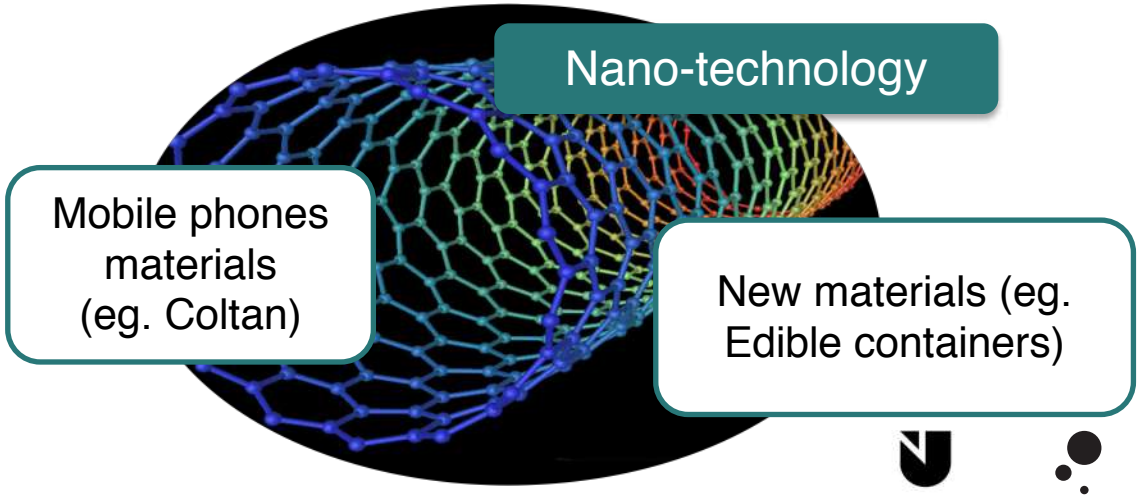
# Examples of socioscientific issues

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# Issues to include in the curriculum

International Journal of Science and Mathematics Education
https://doi.org/10.1007/s10763-018-09947-y

CrossMark

**What Major "Socio-Scientific Topics" Should the Science Curriculum Focused on? A Delphi Study of the Expert Community in China**

Yanlan Wan[1] · Hualin Bi[2]

**Safety and Health:**
Food safety, rationale use of antibiotics

**Resources and Energy:**
Development of clean energy, application of solar energy

**Ecological system:**
Biodiversity loss, destruction of rainforests and wetlands

**Environmental Issues:**
Water pollution, soil pollution, global warming

**Biotechnology:**
Gene therapy, GMO

**New materials:**
Nano-technology

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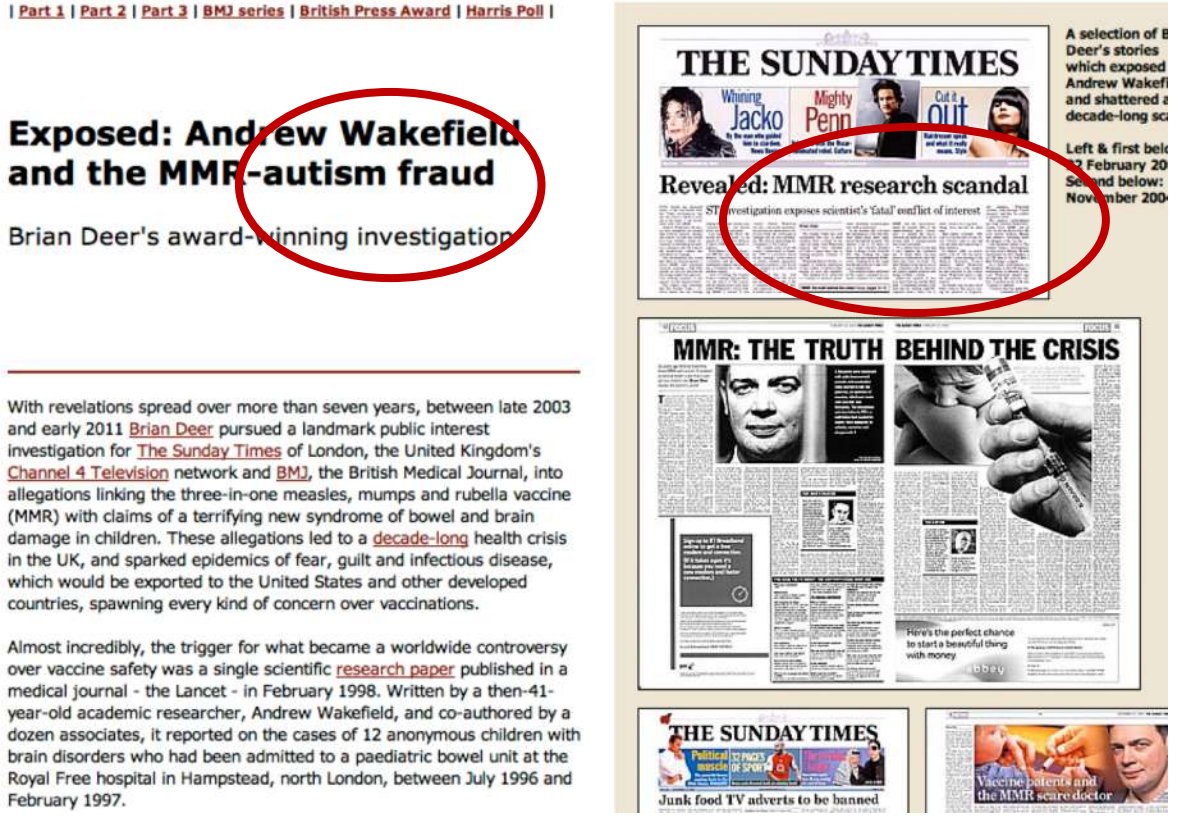



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# What characterises socioscientific learning and teaching?

Recognising reliable evidence and data and making judgement calls


Understanding how to differentiate science from nonscience issues

Taking action on issues relevant to their everyday lives

Decision-making and practical argumentation

Collaborative learning

Situated learning contexts

Character formation

(Zeidler, et al., 2003; Sadler, 2009; Zeidler et al., 2009; Bencze & Carter, 2011; Evagorou, Jimenez-Aleixandre & Osborne, 2011; Nielsen, 2009, 2010, 2012; Evagorou & Osborne, 2013; Zeidler & Nichols, 2009)

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# Rationales for teaching socioscientific issues

Cult Stud of Sci Educ (2009) 4:705–711
DOI 10.1007/s11422-008-9145-6

FORUM

**Socio-scientific reasoning influenced by identities**

**Laurence Simonneaux · Jean Simonneaux**

- Improves knowledge and understanding
- Improves understanding of the nature of science
- Contributes to citizenship education by helping students make informed decisions

**Learning About the Role and Function of Science in Public Debate as an Essential Component of Scientific Literacy**

**Ingo Eilks, Jan Alexis Nielsen, and Avi Hofstein**

C. Bruguière et al. (eds.), *Topics and Trends in Current Science Education: 9th ESERA Conference Selected Contributions*, Contributions from Science Education Research 1,
DOI 10.1007/978-94-007-7281-6_6, © Springer Science+Business Media Dordrecht 2014

- Promotes the perceived relevance of science teaching

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# Rationales for teaching socioscientific issues

Functional Scientific literacy (Vision II)

- Learning **in** science (Developing scientific knowledge)
- Learning **about** science (Understanding the nature of science)
- Learning **to use** science (Invoking science to thematise societal issues)

(Roberts, 2007; Zeidler & Sadler, 2010)

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# Part 2

## What does empirical research say?

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# Findings about students

- Extensive review of the literature on students
  - Sadler & Dawson (2012) - science content knowledge, nature of science, interest and motivation, and argumentation
  - Sadler (2004) - informal reasoning and SSI

- Most of the studies with students are with college students or secondary students, and very few with younger students.

- Some studies include explicit instruction of SSI, and others simply present SSI as a conversation starter,

# Students: Learning **in** science

## The connection between SSI and content knowledge

- SSI-teaching has been documented to improve conceptual understanding (Applebaum et al., 2006; Klosterman & Sadler, 2010; Sadler et al., 2016; Dori et al.; 2003; Venville & Dawson, 2010; Zohar & Nemet, 2002)

- The quality of informal reasoning about SSIs is linked to content knowledge (Flemming, 1986a; 1986b; Tytler et al., 2001; Sadler & Zeidler, 2004)

# Students: Learning **about** science

## Few studies on students' engagement with science

- Students are more motivated to learn science after engaging with SSI (Bennett et al., 2004; Bulte et al., 2006), especially if the SSI they are studying is of personal or global interest.
- Statistically significant differences on students' attitudes towards science after engaging with SSI (Lee & Erdogan, 2007; Yager et al., 2006).

## More evidence for SSI & NOS is needed

- More sophisticated and nuanced epistemological stances, *if* students continuously engage with SSIs (Zeidler et al., 2009)
- SSI-teaching can improve NOS understanding (Herman, 2018; Lewis et al., 2006)
- *But,* teaching NOS in a SSI context does not seem to outperform teaching NOS explicitly (Khishfe & Lederman, 2006)

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# Students: Learning **to use** science

## SSI contexts can improve argumentation skills

- *But* this is highly dependent on the nature and quality of supports provided to students (Andriessen, Baker & Suthers, 2003; Bell, 2004; Evagorou & Avraamidou, 2008; Sadler & Dawson, 2012)
- SSI context can help students improve their argumentation skills (Dawson & Venville, 2010; Grace; 2009; Tal and Kedmi, 2006)
- SSI-argumentation difficult to assess on the fly (Evagorou, 2011; Nielsen, 2012)

## Limited empirical studies on activism and SSI:

- Some SSI-teaching formats increased students' commitment to activism (Benzce et al., 2012)
- Some SSI-teaching led students to recognise themselves as important agents of change (Reis, 2014)

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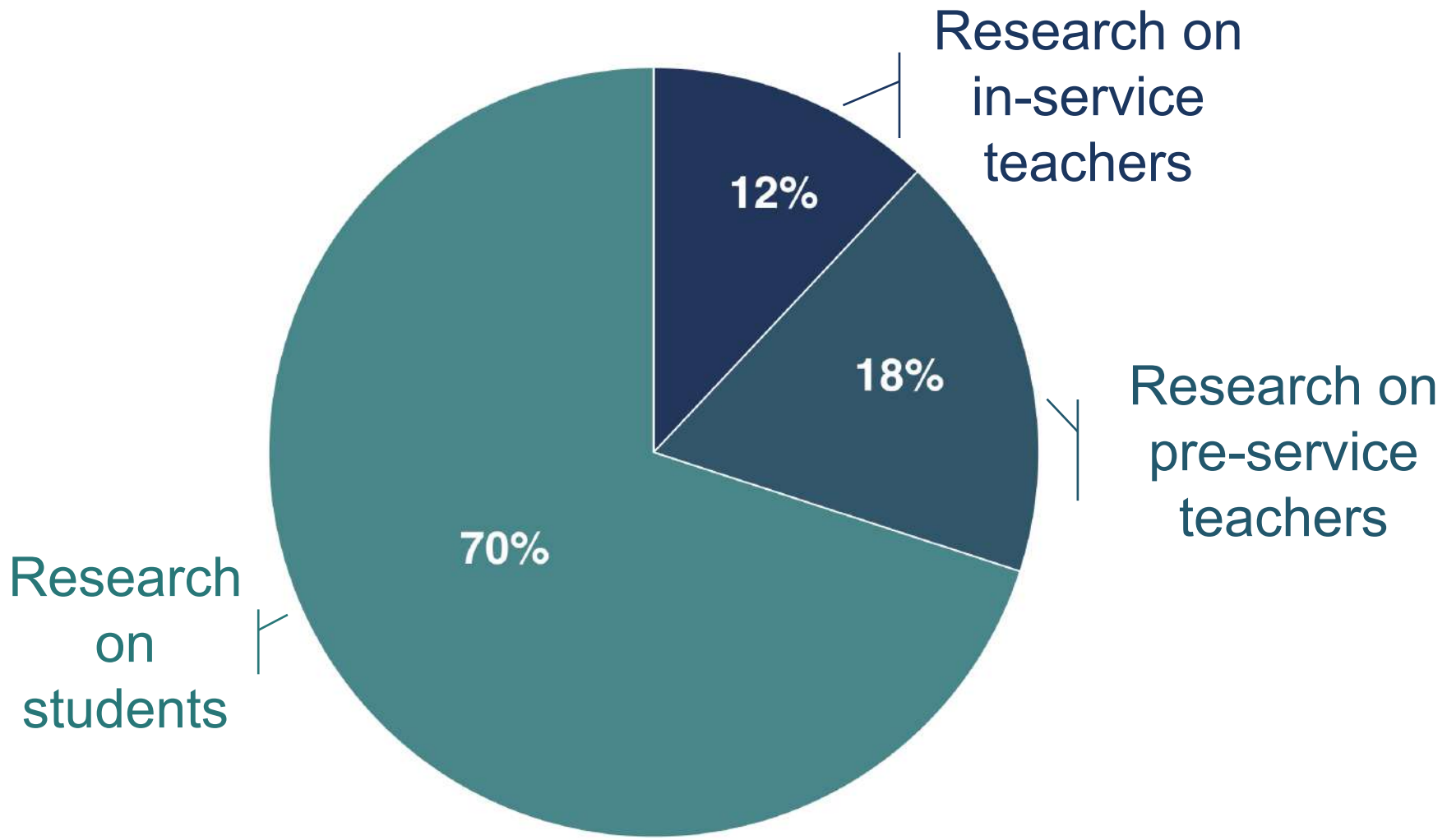
# Topical distribution of empirical papers (1986-2018) (N=485)

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# Pre-service teachers and SSI

- Growing body of research on SSI and pre-service teachers (Nielsen, in print), most on the impact of special workshops woven within teacher training (Evagorou & Puig, 2017; Kilinc et al., 2017)

- Special workshops can have positive effect on PSTs understanding of SSI, but often limited effects on their SSI practice (Garrido Espeja & Couso, in print)

- PSTs' epistemological beliefs seemed to correlate with their ability to engage in informal reasoning concerning SSI (Ozturk & Yilmaz-Tuzun, 2017) and their views of science (Leung et al., in print; Evagorou & Puig, 2017)

# Pre-service teachers and SSI

Teaching SSI puts demand on PSTs:

- to use information and knowledge from outside their scientific domains (i.e., moral, financial, ethical dilemmas) (Simonneaux & Simonneaux, 2008).

- Use skills and competences that might be new to them (coordinating group work, ethics) (Topcu et al., 2010)

- Content knowledge is often impeding implementation of SSI as most of these studies are with elementary school teachers.

# Towards a literature review (1986-2018)

**Aim:**
To establish a systematic overview of the **empirical** research on socioscientific issues that focuses on **in-service teachers**

(Nielsen & Evagorou, in preparation)

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# Review process

Database search in ERIC and WoS:
**TOPIC:**(socioscientific issues) *OR* **TOPIC:**(SSI) *OR* **TOPIC:** (socio-scientific issues) *OR* **TOPIC:** (societal issues) *AND* **TOPIC:** (teach*). **Timespan:** 1986-2018.

↳ Result: **1148** unique publications

↳ Removing publications not about SSI

↳ Result: **716** publications

(Nielsen & Evagorou, in preparation)

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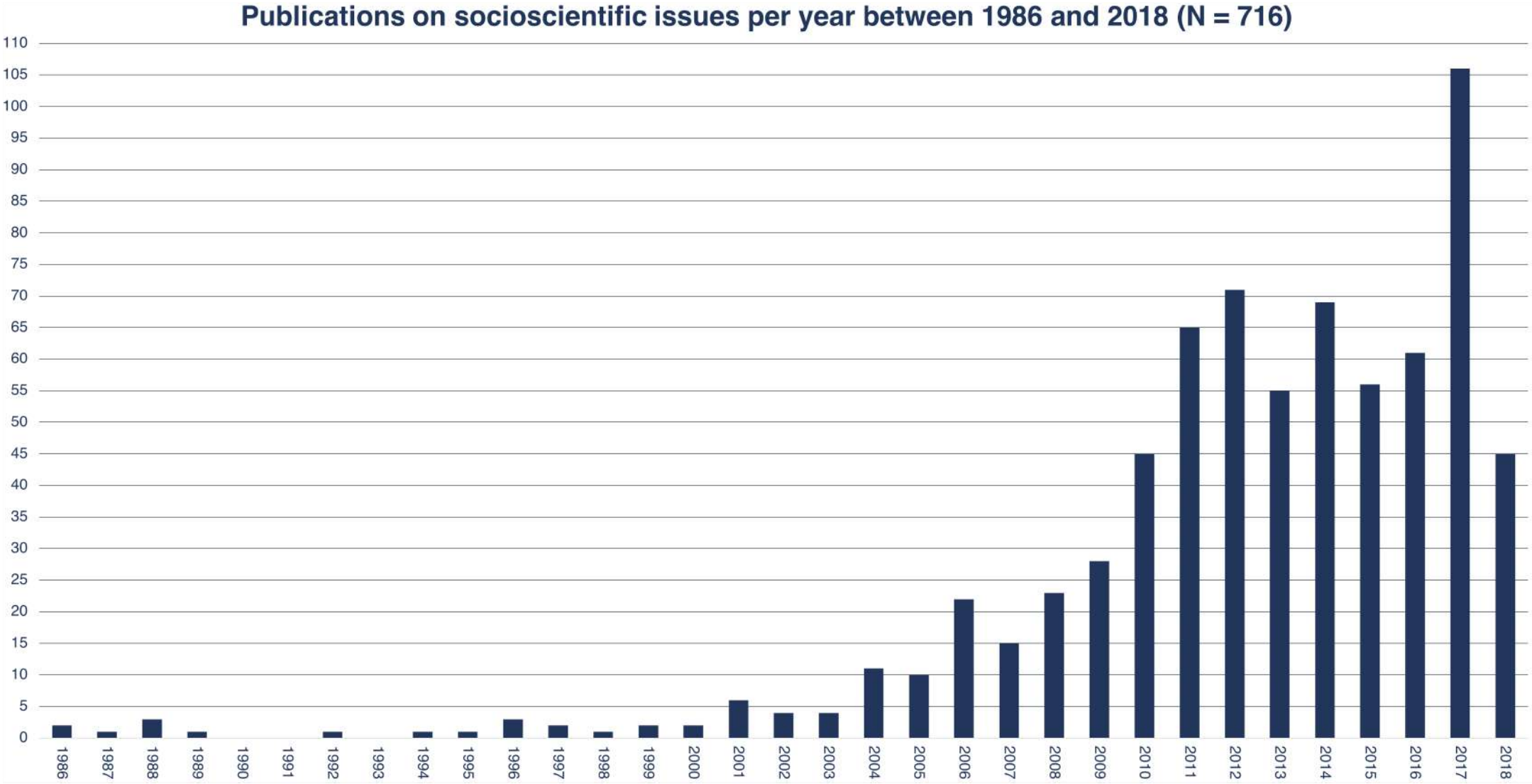


(Nielsen & Evagorou, in preparation)

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↳ Result: **1148** unique publications

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↳ Result: **716** publications

↳ Removing non-empirical papers

↳ Result: **485** papers

(Nielsen & Evagorou, in preparation)

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# Review process

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Result: **1148** unique publications

Removing publications not about SSI

Result: **716** publications

Removing non-empirical papers

Result: **485** papers

Removing papers not on in-service teachers

Result: **72** publications

Removing papers in which
- teachers were only in focus in an *en passant* fashion.
- SSI was only a deep context or rationale for the study
- the methods of the study were not adequately presented

Result: **41** publications

(Nielsen & Evagorou, in preparation)

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| Journal Title | N |
|---|---|
| International Journal of Science Education | 11 |
| Research in Science Education | 6 |
| Book Chapters | 3 |
| Cultural Studies of Science Education | 2 |
| Journal of Science Teacher Education | 2 |
| Journal of Biological Education | 2 |
| Science & Education | 2 |
| African Journal of Research in Mathematics, Science and Technology Education | 1 |
| The Curriculum Journal | 1 |
| International Education Studies | 1 |
| Journal of Research in Science Teaching | 1 |
| Science Education | 1 |
| Teaching and Teacher Education | 1 |
| Journal of Agricultural Education | 1 |
| International Research in Geographical and Environmental Education | 1 |
| European Journal of Science and Mathematics Education | 1 |
| International Journal of Science and Mathematics Education | 1 |
| Cambridge Journal of Education | 1 |
| Teachers College Record | 1 |
| Journal of Science Education and Technology | 1 |

(Nielsen & Evagorou, in preparation)

# Themes in the research corpus

**22**

Teachers' perceptions, views, motivations or attitudes related to SSI

**11**

Examining teaching strategies that support SSI

**5**

Challenges implementing SSI in classroom

**5**

Evaluating PD aiming to support SSI teaching

**3**

Differences between science teachers and teachers from other disciplines

**3**

Assessment of SSI

**1**

Content knowledge and SSI

(Nielsen & Evagorou, in preparation)

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# Methods in the research corpus

**Qualitative methods: 33 publications**

**Quantitative methods: 1 publication**

**Mixed methods: 7 publications**

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**34** Interviews

**10** Lesson observations

**9** Case studies - short term and longitudinal

**9** Reflections

**3** Action research

**6** Focus group discussions

(Nielsen & Evagorou, in preparation)

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# Remarks about methods in the corpus

- A large portion of the studies were contextualized in auxiliary PD programs
- All most all studies use convenience samples
- Larger samples only have to do with teachers' perceptions vis á vis SSI

(Nielsen & Evagorou, in preparation)

# Overview of findings

## Self-efficacy & support

Teachers can be reluctant to teach SSI due to concerns about their abilities, time constraints and lack of support materials
(Pitiporntapin & Srisakuna, 2017; see also Ekborg et al., 2013; Saunders & Rennie, 2013).

## Teacher focus

Teachers often have a content-centred interpretation of SSI; they teach SSI in order to teach content; reduce SSI to specific content (Tidemand & Nielsen, 2017).

## Pedagogical approach

Teachers often turn to teacher-centred activities emphasising on content or facts of science as a way to cope with the pedagogical challenges of SSI (Day & Bryce, 2011).

## Guiding students

Some teachers lack confidence in monitoring student discussion (e.g Bryce & Gray, 2004) and find it difficult to facilitate students' search for, and critical examination, of information (Ekborg et al., 2013)

(Nielsen & Evagorou, in preparation)

# Overview of findings

## Teacher development

The use of the specific models in training may help teachers to develop a stronger pedagogical base to support their teaching and learning about SSI and by using the model they increased teachers' knowledge about ethical frameworks (Saunders & Rennie, 2013)

## Avoiding assessment

Science teachers avoid assessing students' competences related to SSI – expecting that this is done in other disciplines (e.g. Steffen & Hößle, 2017)

## Content-oriented assessment

Science teachers tend to devalue SSI-relevant assessment criteria (e.g. Steffen & Hößle, 2017) and they instead tend to focus on the science disciplinary content when assessing students (Christenson, Gericke & Rundgren, 2017; Tidemand & Nielsen, 2017)

(Nielsen & Evagorou, in preparation)

# Synthesis of the reviewed corpus

Implementing full-fledged SSI-teaching is difficult for science teachers for a number of constrains. In particular, lack of…

- guidance,
- SSI-PCK,
- resources,
- deep understanding of ethical frameworks,
- (perceived) ability to manage discussions and debate in the classroom,
- assessment criteria.

(Nielsen & Evagorou, in preparation)

# Science Teacher Education for Responsible Citizenship: Towards a pedagogy for relevance through socio-scientific issues

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**Activity**

Now you have seen the main empirical findings from SSI studies.

Discuss with your neighbour (2 min). ***What is the most important focus for future research in SSI?***

Type answer on www.menti.com
use code XX XX XX

# Part 3


## Searching for new perspectives

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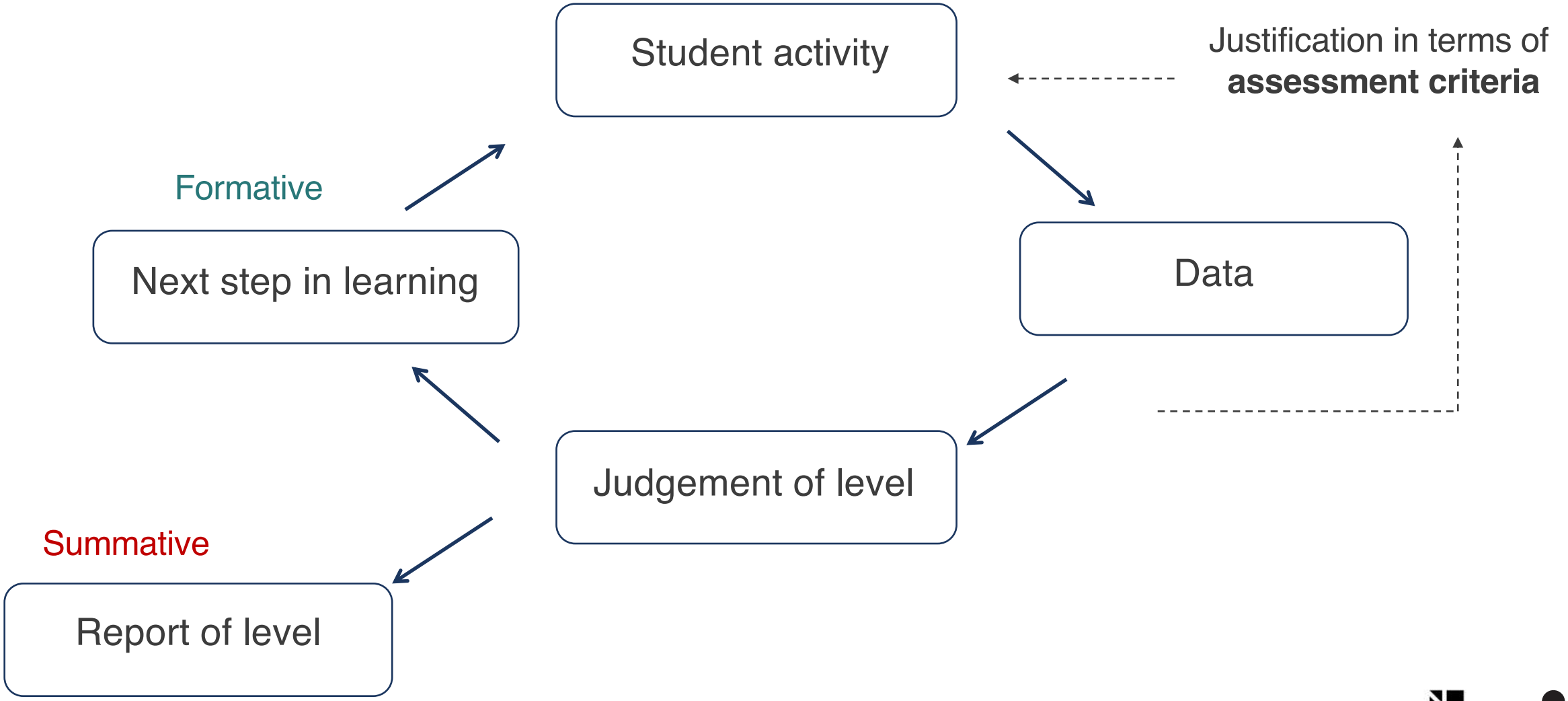
# Issues concerning assessment of SSI




(after Harlen, 2013)

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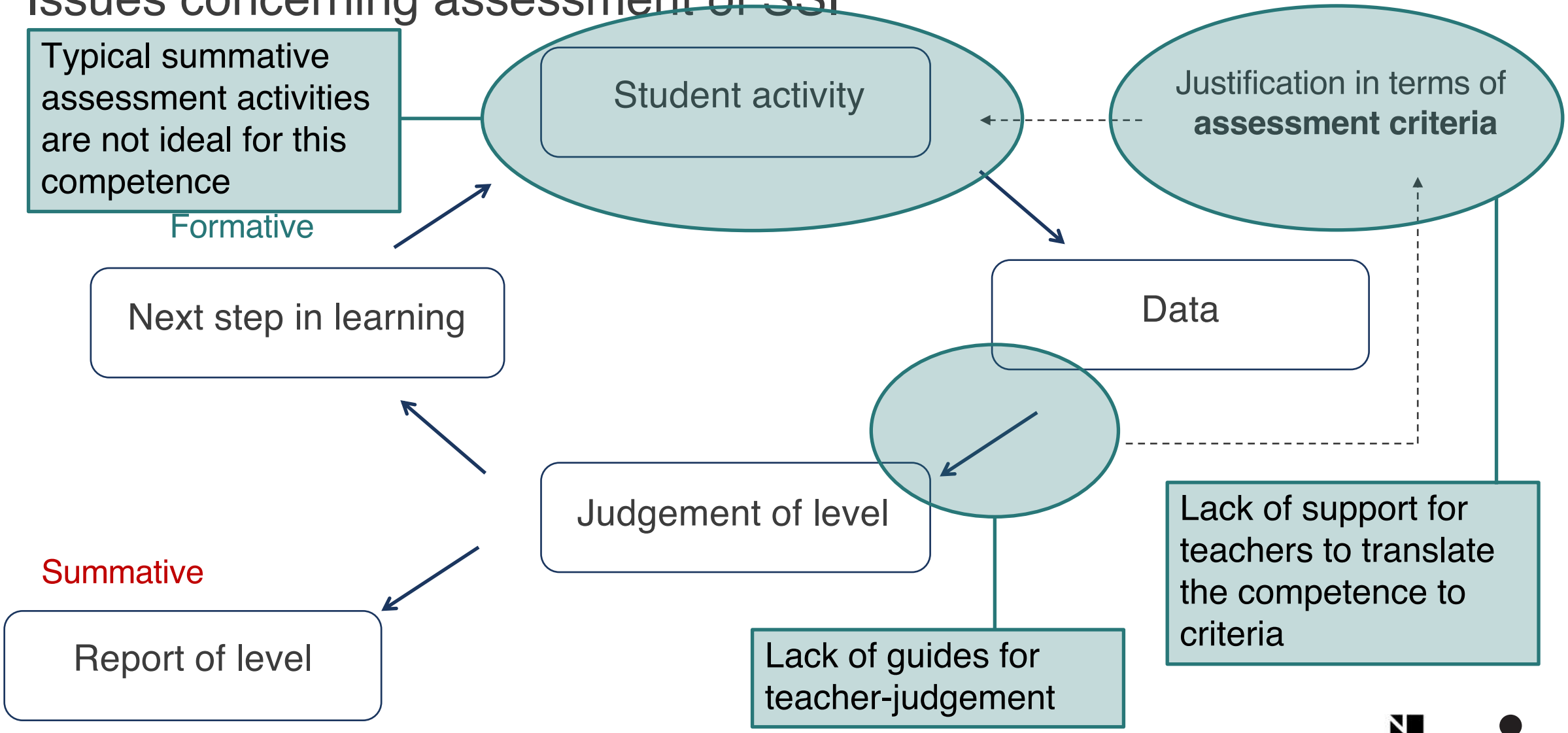
# Issues concerning assessment of SSI

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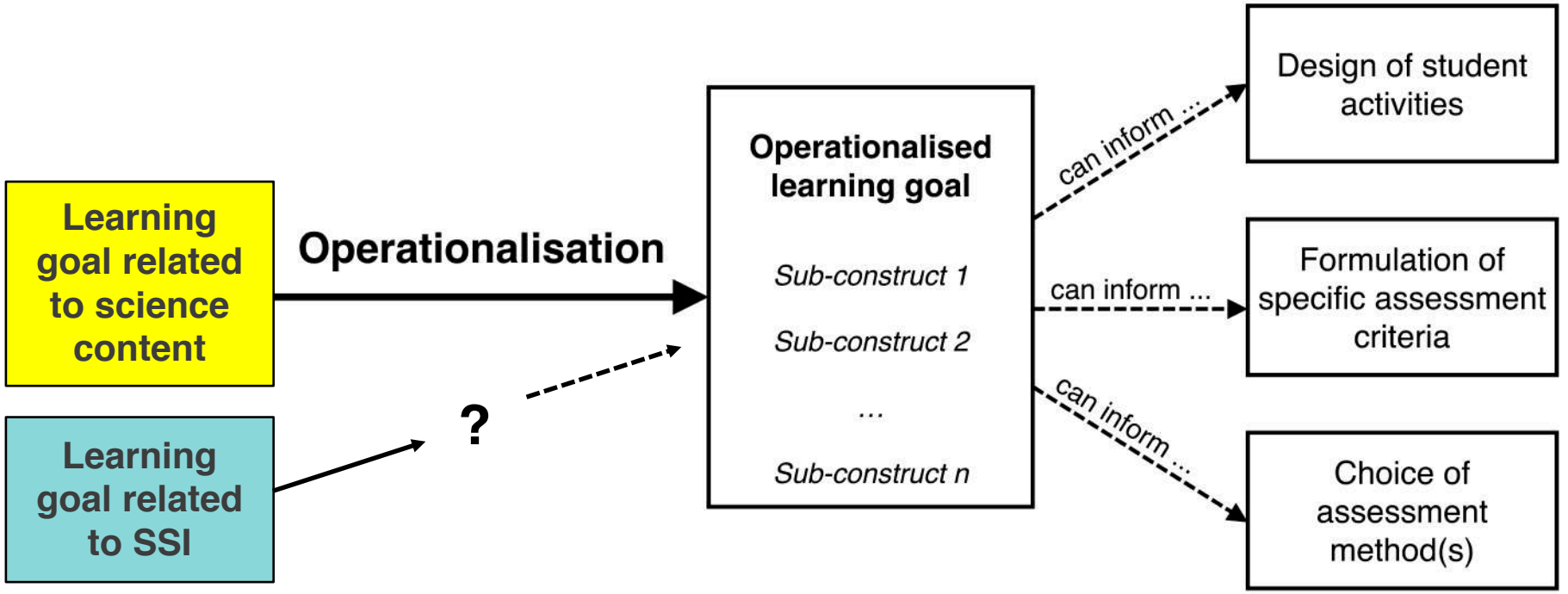
# Issues concerning assessment of SSI




**Transforming Assessment Research: Recommendations for Future Research**

**Jan Alexis Nielsen, Jens Dolin, and Sofie Tidemand**

J. Dolin, R. Evans (eds.), *Transforming Assessment*, Contributions from Science Education Research 4, DOI 10.1007/978-3-319-63248-3_11

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# PD or not PD?

- Very few models of SSI PD supported by empirical data (Saunders & Rennie, 2013; Friedrichsen, Sadler & Zangori, in print)
    - Long term professional development with in class support vs. no PD (Friedrichsen, Sadler & Zangori, in print; Bayram-Jacobs et al., 2019)
    - Using specific teaching frameworks that can be applied in the classroom (Saunders & Rennie, 2013)
    - Teacher ownership and co-creation of materials vs. materials designed by researchers and implemented by teachers (Friedrichsen, Sadler & Zangori, in print; Bayram et al., 2019)

# SSI and teachers' background

> *"A prospective teacher's personal view of teaching science […] is a strong predictor of a prospective teacher's actual practice of teaching science*" (Crawford, 2007, p. 637)

Teachers' background:

- Specialists who insist on teaching knowledge (Tidemand & Nielsen, 2017) vs. non-specialists (Garrido Espeja & Couso, in print)
- Understanding of the nature of science/vision of science (Leung et al., inprint)
- Lack teaching skills (coordinating discussions, making decisions) (Bryce & Gray, 2004)
- Personal experiences (Lee and Witz, 2009)

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# Four questions for the future of SSI-research

1. What are the remaining empirical blind spots in the SSI-literature?
2. What are good ways to weave learning to teach SSI into traditional teacher education?
3. What changes are needed to move SSI-research into providing more conclusive findings?
4. What changes in policy and assessment are needed to increase the uptake of SSI-teaching?

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# Thank you for your attention!

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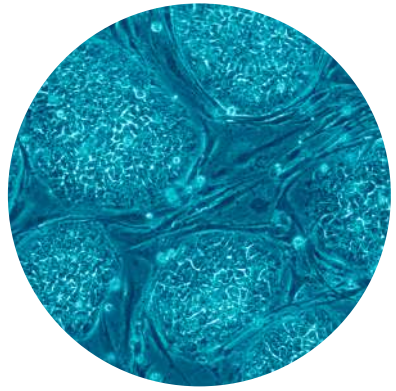

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